drop harmlessly down. The grand entrance, which is usually placed on the south side, is the member of the fortification on which the builder has chiefly displayed his artistic skill. Some of them are very beautiful. They of course exhibit the semicircular arch of the Norman style and the characteristic zig-zag ornament. The windows of the building, when windows are admitted as they usually are on the second and third stories—especially on the side least exposed to the enemy—are generally comparatively small and nearly devoid of ornament. The internal arrangements of the keep may now obtain our attention. In the large buildings the interior area is divided into two or three compartments by stone walls rising from the ground to the summit of the building. The object of this arrangement has been, not so much its economical convenience as its military advantages. In the event of one compartment of the castle being got possession of by an enemy, the other might be successfully held out against them by closing the gates of communication. From the top to the bottom of the building a newel staircase usually ran. In the lower part of the building this was the only means of communication with the several stories, for the builders have evidently contemplated the possibility of an enemy getting possession of the ground-floor, and yet being kept at bay. In the upper part of the building, where the same reason could not exist, greater freedom of communication is enjoyed, and two or more staircases exist. The structure of the newel staircase is curious; it is turned round a central pillar, and is vaulted above. The erection of this spiral vaulting must have been a work of some difficulty. Another essential requisite in a Norman keep was the well. Without it no garrison could maintain a siege. In many cases the labour involved in sinking it was very great. At Carisbrook Castle, in the Isle of Wight, the well is said to have been 300 feet deep. At Bamborough Castle the well is sunk to the depth of 145 feet, through a whinstone rock. It was not sufficient, however, that a well was provided, to which access might be had in the basement story—the comfort of the garrison required that it should be easily accessible from the higher parts of the building. At Rochester the pipe of the well is continued from the ground to the highest floor of the building: an arched opening communicates with each story. At Newcastle a contrivance is adopted which is probably peculiar to this keep. The well is only accessible from the third story, the pipe enclosing it being continued up to this elevation without there being any intermediate opening in its solid masonry. The builders have evidently contemplated the possibility of the lower portions of the building being in the possession of the assailants without the garrison being obliged to surrender. This precaution, however, not only involved the labour of raising every bucket of water that was wanted for any part of the castle to this elevation, but the additional labour of carrying to the apartments below what was required there. To remedy, in part, this inconvenience, pipes have been laid in the walls and pillars of the building from the well-room to the lower parts of the structure. Some portions of them yet remain. In castles of a moderate size, the principal room of the lower story is vaulted, a central column supporting the radiating ribs of this arrangement. In time of a siege, this apartment was probably the residence of the common troops of the garrison. Pent up here day and night in considerable numbers, their situation would not be of an enviable kind. As being a little removed from the immediate source of danger, more light is usually admitted into the second story than the first. This, however, is done with some care. At Rochester nothing larger than an arrow loop is allowed in the second story. In addition to the principal apartments in the interior area of the keep, we have smaller ones situated within the thickness of the walls. The massive nature of the building admits of the formation of tolerably convenient apartments in these situations. They are uniformly vaulted in the roof. In order to prevent the strength of the wall being materially damaged by this arrangement, care is taken not to have these rooms similarly placed in consecutive stories. If the mural chamber be in the south wall on the second story, it is probably in the north wall in the third. These chambers have probably been used as the retiring rooms of the chief occupants of the fortress. We occasionally meet with fire-places on the second story. These consist of little more than a hearth, from which a funnel-shaped channel, terminating in an opening resembling an arrow-loop, takes the smoke to the outside of the building. It is a curious circumstance, that in some keeps no traces of a fire-place are to be found in any part of them. This is the case at Richmond, and more remarkably still in the Tower of London. It would appear that in ancient days the luxury of a fire was less freely enjoyed than now. The hardy sea-kings of Norway thought it effeminate to sleep beneath a roof, and the warriors of the middle ages considered a blazing hearth as unbefitting the profession of arms. The grand hall in most castles of importance occupies the third story. As at this elevation the strength of the walls is of less importance than below, windows are more freely inserted. Near the upper part of the keep, and within the thickness of the walls, a passage ran entirely round it. This has probably been to enable the garrison in time of a siege freely to communicate with every part.

Mr. Bruce here described the mode of operation of a sallying party, taking Newcastle as his guide; and next discussed the question of whether underground dungeons were common in Norman keeps; and said,—I have at length come to the conclusion that underground dungeons were the invention of a subsequent period—the Edwardian—and, strange as the assertion may appear, that they were proofs of advancing civilization. In the fearful struggle between Saxon and Norman that followed the advent of William on our shores, human life was esteemed a thing of nought. No Norman was safe outside the walls of his keep, except he were accompanied by a strong guard; and when policy dictated, the Normans did not hesitate to exterminate every living thing, and to subvert every habitation in extensive districts. Dungeons were of little use to the Normans. If they caught a foe that was worthy of their attention, they gave him six feet of earth, or, if he were a tall man, seven. These castles are land-marks in the tide of time; they are memorials of the past, which call upon us to be grateful for present mercies. How miserable the condition of these Norman nobles. Look at the gloomy pile, and say is it not a prison—a prison into which we would now shudder to put a felon. Yet these prisons, these above-ground pits, the Norman nobles built for themselves—they voluntarily incarcerated themselves, and unlike modern criminals, they used their best endeavours to keep their prison doors fast, and to resist the efforts of those without to throw them open. How piteous their lot when compared with the cottager of England at the present day—he is free to go where he likes, and when he likes, and should the hand of violence uplift his latch or affect his person, the might of Britain is put forth to protect him. Long may we enjoy our present comforts—let these enjoyments go on in an increasing ratio—but to understand and appreciate them let us preserve and study our Norman Castles.

THE FAILURE AT THE BRICKLAYERS' ARMS RAILWAY STATION.

The doctrine of the coroner who held the inquest on the body of the poor man killed by the fall of the roof at the Bricklayers' Arms Station,—that the jury were not to inquire into the sufficiency or otherwise of the roof,—unsound, and should be reprobated.

For the safety of the public an investigation was demanded, and should have been made. No roof should be constructed so that the fracture of a single column should bring down the whole,—in this case more than 400 feet in length.* The fact is, unless we greatly err, this roof was waiting to fall. The third span, which still stands (two are entirely gone), is in a very insecure state; the columns are pushed considerably out of upright, and require immediate attention, to prevent another accident.

What appears to be a new passenger-shed, of great extent, is being erected at this station, adjoining the site of the fall: Mr. Kelk is the contractor engaged upon it. We could not learn the name of the architect or engineer under whose superintendence it is being constructed, and we are rather glad of it, since we feel it to be our duty to call immediate attention to the insufficiency of the roof which is placed upon it. This is in two divisions, each having a span of more than 70 feet, and is carried in the centre on small hollow iron columns, 20 feet apart. It is a queen-post roof, the place of the posts being occupied by light iron rods: the rest is of timber. Telford's formula gives for a span of 70 feet, a tie-beam, 15 in. by 11½ in., and principal rafters 9 by 7, the trusses being 10 feet apart. Even those who have come to think Telford over-cautious, will be astonished to learn that in this new roof at the Bricklayers' Arms station, the tie-beam is but 13½ in. by 6½ in., and the trusses 20 feet apart. We unhesitatingly assert that the roof is insufficient: if exposed to any accidental disturbing causes, failure must be expected, and, on the part of the public, we call for supervision. If we may judge from the secretary of the company, who wants a main requisite for his position, namely, good manners, this warning will be disregarded: in that case we must look to the government superintendent.

* We have been complained of for having attributed the fall of the roof to the failure of one column: our statement, however, was fully confirmed at the inquest.

A FEW GROPINGS IN PRACTICAL ACOUSTICS.*

As a branch of physical science, acoustics are understood in a general way; and various leading phenomena which will be here touched upon, most inquiring minds are familiar with; but we are not so well versed in their relation to our buildings as to our musical instruments, nor are we apt to look to the analogy which may subsist between the former and the latter,—in that, besides the propagation of sounds, the tempering agency of *dampers* demands attention. Such, however, we feel assured, is the case, and is deserving of closer consideration.

Sound diverges alike in all directions, and in all weathers, seasons, temperatures, with the same velocity—unless impeded or accelerated by wind—and wherever it strikes, it is reflected at a like angle,—propagating itself by means of the obstacles with which it comes in contact: while the *distance* which it travels, therefore, depends on its original force, and subsequent reverberations, its *rate* is not at all influenced by these circumstances. The effect of the wind we may observe in the ringing of church bells in the distance, the sound of which, by turns, swells out, and sinks and dies away. The vibratory action of sound on the atmosphere is rendered visible by its affecting the motes in the sunbeam,—also disturbing cobwebs, and water in glasses: in concord, it will even shake small pieces of paper off a string.

The Air, to which we are indebted for hearing not merely rude noises and low murmurs, but musical sounds, and the delicate inflections of the human voice constituting speech, being the general medium of sound, its conducting power has from time to time engaged the attention of various philosophers, and the *velocity* assigned by these has been variously stated as follows:—

	Feet per second of Time.
Cassini and the French Academicians	1,172
The Florentine Academy	1,148
And Halley, Flamsteed, and Derham	1,142

The latter deduction has been that usually adopted; but later experiments, having a more careful regard to the temperature of the atmosphere, have indicated 1,130 feet, at 32° of Fahrenheit, as approximating more closely the actual velocity. With this datum, and considering light (from its extreme celerity) as being instantaneous, we are enabled to infer the distance of visible objects producing sounds—having only to multiply the seconds which elapse by the feet per second.

Other fluids besides air are conductors of sound; and their relative power in this respect proves to be as their density: thus, amongst the results of experiments made by Biot, Berthollet, and Laplace, on the vapours of water, spirits of wine, and ether, the relative distances at which a sound could be heard in the atmosphere, and in vapour of ether, appear as 158¾ and 143¼ yards. It has been found, that the tone which a sonorous body will produce is sharper in hydrogen gas, and graver in carbonic acid gas, than in atmospheric air. Now, the specific quantities of these respectively we know to be—

Hydrogen gas	0·074
Atmospheric air	1·000
Carbonic-acid gas	1·520

And the inference becomes obvious, that there exists an important connection between acoustics and ventilation, pure air being favourable to the conduction of sound, and that which has become loaded with carbonic acid the reverse. In fact, we have observed the muffled tone of a preacher's voice in an afternoon's service, as compared with the same in the morning. In like manner, as refraction of the rays of light is produced in water by its encountering the denser body, so, it is allowed, a gaseous body, denser than the atmosphere, such as a cloud, will refract or even reflect sound; hence its tendency to retard it is obvious. Mr. Curtis, in his treatise on the ear, has express reference to the influence which the state of the atmosphere exercises on the organ of hearing, and states that it seldom happens that those who live in a humid or impure air possess acute

* See various other papers on this subject in our previous volumes.